

# **AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)**



**FOR  
STRUCTURAL  
(3E3X1)**

**MODULE 17**

**STRUCTURAL LAYOUT/FRAMING COMPONENTS**

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STRUCTURAL LAYOUT/FRAMING COMPONENTS

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Career Field Education and Training Plan (CFETP) references from 1 August 2002 version.

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Supersedes AFQTP 3E3X1-16, 14 Jul 00

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Pages: 28/Distribution F

**Notice.** This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

# AIR FORCE QUALIFICATION TRAINING PACKAGES

## FOR

## STRUCTURAL

### (3E3X1)

### INTRODUCTION

**Before starting this AFQTP**, refer to and read the "[AFQTP Trainer/Trainee Guide](#)"

**AFQTPs are mandatory and must be completed** to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP **does not** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

***AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.***

### **MANDATORY minimum upgrade requirements:**

**Core task:**

- AFQTP completion
- Hands-on certification

**Diamond task:**

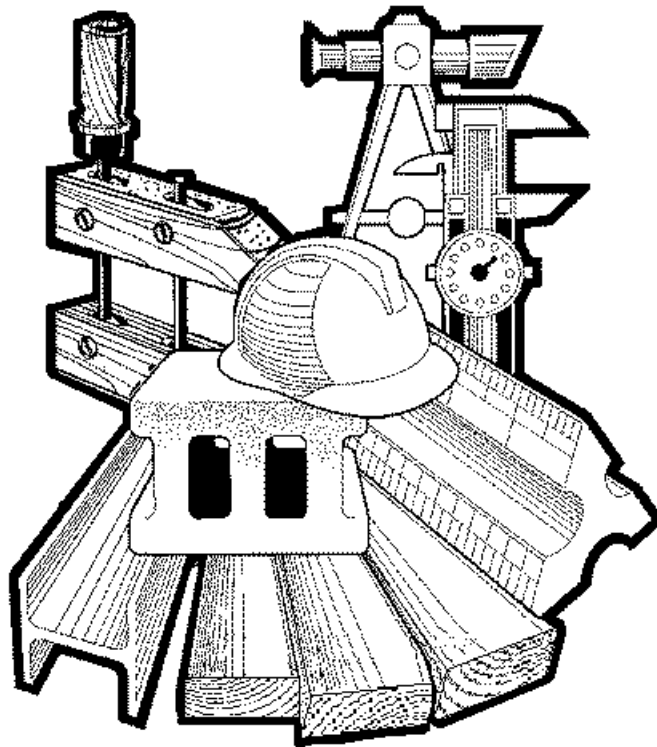
- AFQTP completion
- CerTest completion (80% minimum to pass)

**Note:** *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

***Put this package to use.*** Subject matter experts under the direction and guidance of HQ AFCESA/CEOF revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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## LAYOUT, CONSTRUCT, AND INSTALL:

MODULE 17

AFQTP UNIT 1

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### FLOORS (17.1.1.)

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**LAYOUT, CONSTRUCT, AND INSTALL FLOORS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	17.1.1. – Layout, construct, and install floors.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Career Development Course (CDC) Structural Journeyman 3E351C, Volume 1, Unit 4, Section 4-1, Lesson 033; <i>Floor and Wall Framing</i>.</li> <li>2. Commercial Manual, <i>Modern Carpentry by Willis H. Wagner, 1992</i>.</li> <li>3. Commercial Manual, Carpentry 3<sup>rd</sup> Edition, Delmar.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E331 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. CDC Structural Journeyman 3E351C, Volume 1, Unit 4, Section 4-1, lesson 033. 4-1.</li> <li>2.2. Modern Carpentry, Unit 7, Floor Framing, pages 149-171.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. 25' tape measure.</li> <li>2. Pencil.</li> <li>3. Circular saw.</li> <li>4. Extension cord.</li> <li>5. Speed square.</li> <li>6. Chalk line.</li> <li>7. Lumber.</li> <li>8. Framing hammer.</li> <li>9. Nails, 16d common.</li> <li>10. Safety glasses.</li> <li>11. Hearing protection.</li> </ol>
<b>Learning Objective:</b>	The trainee should know how to layout and construct a 2" x 6" wood-framed floor with little or no supervision.
<b>Samples of Behavior:</b>	The trainee should demonstrate how to layout and construct a 2" x 6" wood-framed floor.
<b>Notes:</b>	
Any safety violation is an automatic failure.	

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## LAYOUT, CONSTRUCT, AND INSTALL FLOORS

**1. Background.** As a structural journeyman, you may be required to build floors during your career. Floor joists are horizontal framing members of a floor. They rest on and span from sill to girder or sill to sill. Nominal 2" thick lumber placed on edge is generally used for residential construction. In commercial construction, steel or wood may be used. Floor joists are usually spaced 16" on center and placed crown up. However, they may be spaced 12" or 24" on center depending on the load.

**2. Procedures.** Follow these steps to layout, construct, and install floors:

**NOTE TO TRAINER/CERTIFIER:**

If a floor construction project is not available, the minimum required for upgrade training is the following: Step 1 (all); Step 2 (place material on the floor and secure two floor joists to one joist header); Step 3 (demonstrate layout and installation procedures).

**Step 1: Select straight lumber for the joist headers.**

- 1.1. Layout the floor joists spacing onto the joist headers according to the plans and/or building codes.
- 1.2. Place an X on the side of the line where the joist will be located. This will help avoid the confusion of which side of the line to use.
- 1.3. Measure and mark the joist headers length (same length as the sill plate).

**NOTE:**

The joist header caps the ends of the floor joists. It is sometimes referred to as a band joist, rim joist or box header.

**Step 2: Cut and install joist headers and floor joists.**

- 2.1. Cut joist headers to length.
- 2.2. Measure and cut floor joists to length (floor width minus the joist headers thickness).
- 2.3. Place the joist headers and floor joists on edge resting on the sill plates.
- 2.4. Secure the joists (crown up) to the joist headers using three 16d nails.
- 2.5. Square the frame and toenail the joist headers to the sill plate every 16".
- 2.6. Cut and install bridging per the job requirements (usually never greater than 8' intervals). Measure and snap a chalk line on top of the floor joists for reference. If using solid bridging, install alternately from one side of the line to the other.

**NOTE:**

The installation sequence varies with the size of the project. Some jobs require the joists to be toenailed to the sill plates and girders with 10d nails. The joist ends are inset the thickness of the joist header. The joist headers are then nailed to the joists at the top and the bottom of each

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**Step 3: Install plywood subfloor.**

- 3.1. Snap a chalk line on top of the floor joists where the top of the plywood sheet will lay. Install the first sheet parallel to the floor joists starting from the corner from which the joists were laid out.
- 3.2. Install the first row to the chalk line and adjust the floor joists to correct any bend or warp. The ends of the sheets must fall on the center of the floor joists.
- 3.3. Install the second row starting with a half sheet. Continue with a full sheet.
- 3.4. Install the remaining rows being sure to alternate between full and half sheets.

**NOTE:**

For expansion, leave a  $\frac{1}{16}$ " space at the panel ends and a  $\frac{1}{8}$ " space along the panel edges. Refer to the job specifications for the correct nail spacing. The general spacing is 6" on center along the ends and 12" on center intermediately with either 6d or 8d screw or ring-shank nails.

**REVIEW QUESTIONS  
FOR  
LAYOUT, CONSTRUCT, AND INSTALL FLOORS**

QUESTION	ANSWER
1. In most residential construction, nominal 2" thick material is used for floor joists.	a. True. b. False.
2. Floor joists can span from sill to sill or from sill to girder.	a. True. b. False.
3. Floor joists may be spaced from 12" to 24" on center.	a. True. b. False.
4. The joist header is nailed to the joists using three 10d nails.	a. True. b. False.
5. Bridging is installed at no greater than 8-foot intervals.	a. True. b. False.

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## LAYOUT, CONSTRUCT, AND INSTALL FLOORS

### PERFORMANCE CHECKLIST

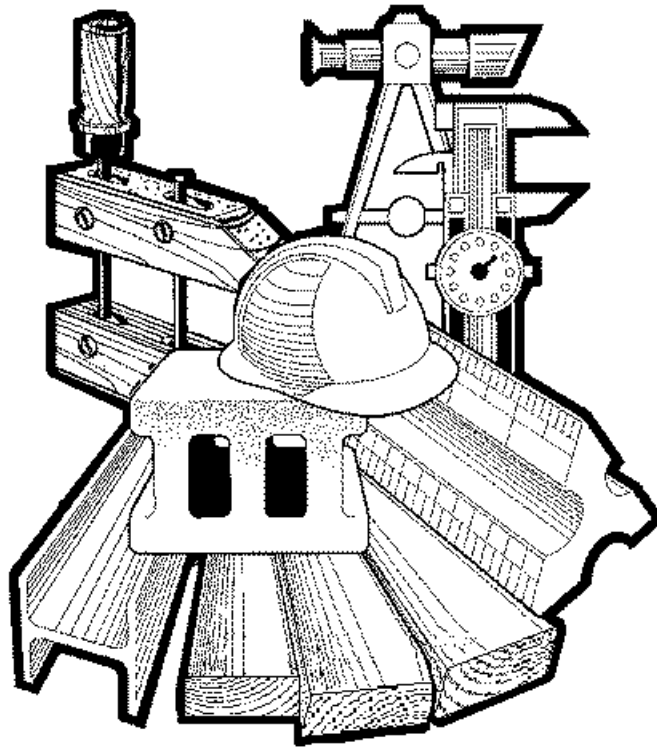
#### INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. properly layout the joist headers at the proper spacing?		
2. attach the joists to the joist headers using three 16d nails?		
3. install all joists crown up?		
4. square the floor frame before toenailing the joist header to the sill plate?		
5. install the bridging alternately on the centerline?		
6. install the plywood sheathing perpendicular to the floor joists?		
7. stagger the rows of sheathing?		
8. leave the required space between the sheets for expansion?		
9. comply with all safety requirements?		

**FEEDBACK:** Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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## LAYOUT, CONSTRUCT, AND INSTALL: (WALLS)

MODULE 17

AFQTP UNIT 1

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### WOODEN STUDS (17.1.3.1.)

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## LAYOUT, CONSTRUCT, AND INSTALL WALLS USING WOODEN STUDS

### Task Training Guide

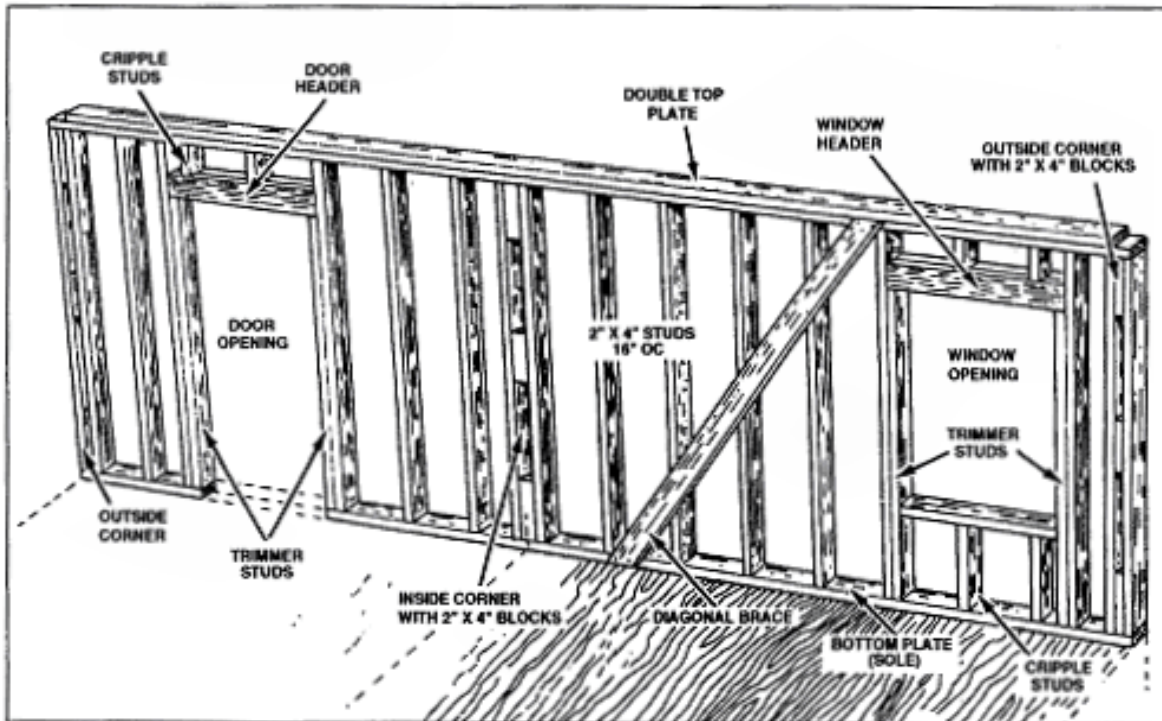
<b>STS Reference Number/Title:</b>	17.1.3.1. – Layout, construct, and install walls with wooden studs.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Career Development Course (CDC) Structural Journeyman 3E351C, Volume 1, Unit 4, Section 4-1, Lesson 033; <i>Floor and Wall Framing</i>.</li> <li>2. Commercial Manual, <i>Modern Carpentry by Willis H. Wagner, 1992</i>.</li> <li>3. Commercial Manual, <i>Carpentry 3<sup>rd</sup> Edition, Delmar</i>.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E331 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. CDC Structural Journeyman 3E351C, Volume 1, Unit 4, Section 4-1, Lesson 033.</li> <li>2.2. Modern Carpentry, Unit 8, Wall and Ceiling Framing, pages 172-188.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. 25' tape measure.</li> <li>2. Pencil.</li> <li>3. Circular saw.</li> <li>4. Extension cord.</li> <li>5. Speed square.</li> <li>6. Chalk line.</li> <li>7. Lumber.</li> <li>8. Framing hammer.</li> <li>9. Nails, 16d common.</li> <li>10. Safety glasses.</li> <li>11. Hearing protection.</li> </ol>
<b>Learning Objective:</b>	The trainee should know how to layout and construct 2" x 4" wood-framed walls with little or no supervision.
<b>Samples of Behavior:</b>	The trainee should demonstrate how to layout and construct wood-frame wall systems.
<b>Notes:</b>	
Any safety violation is an automatic failure.	

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## LAYOUT, CONSTRUCT, AND INSTALL WALLS USING WOODEN STUDS

**1. Background.** As a structural journeyman, you may be tasked to layout, construct and install walls during your career. Knowing how to properly construct walls is critical. They are the main support frame for upper floors, ceilings and roof framing, not to mention they serve as nailing bases for interior/exterior wall coverings. Imagine the consequences of not building a wall to the designed specifications—it could be disastrous. You need to ensure that you not only know how to build and erect walls, but that you follow local building codes and job specifications for the project you're on. Obviously, the first step is to identify the framing members, their functions and locations (Figure 1-1).

**Figure 1-1. Wall Members.**



**2. Procedures:** Follow these steps to layout, construct, and install walls using wooden studs:

**NOTE TO TRAINER/CERTIFIER:**

If a wall construction project is not available, the minimum required for upgrade training is the following: Trainer will provide trainee with wall dimensions to include a rough opening, an outside corner post and a partition. Trainee must then accomplish steps 1 – 7. Steps 8 – 13 must be demonstrated step-by-step ensuring trainee has complete knowledge of tasks.

**Step 1: Determine wall length.** To find the wall length for exterior walls, measure the foundation from corner to corner. On interior walls (partitions), refer to floor plans.

**Step 2: Select bottom plate and top plate.**

**2.1.** If the wall is 16' or less, make plates out of solid lumber. Plan for any joints on the center of a stud.

**2.2.** Ensure lumber is as straight as possible. Warped lumber may lead to a crooked wall.

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**NOTE:**

Use treated lumber for the sole plate if it is to be anchored to concrete. Lay the sole plate beside the anchor bolts and transfer the bolt locations to the sole plate. Drill the bolthole  $\frac{1}{4}$ " larger than the anchor bolt.

**Step 3: Cut plates according to the measurement identified in Step 1.**

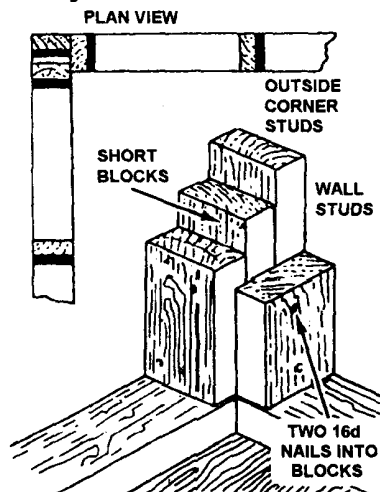
**Step 4: Layout plates for wall openings.**

- 4.1. Refer to the floor plan for the window centerlines (WCL) and door centerlines (DCL).
- 4.2. Measure the distance to WCL and/or DCL from one end of the plates. Using a square, strike a line and mark the proper identification on the plates (i.e. WCL).
- 4.3. Add the desired framing allowance to the size of the opening.
- 4.4. Divide the rough opening width in half. Measuring from the centerline, mark each half of the opening.
- 4.5. Using a square, place a line  $1\frac{1}{2}$ " to the outside of the rough opening width line on each side of the centerline. Place a "T" for trimmer in between these lines. Place an "X" for stud locations outside of each trimmer stud.

**Step 5: Layout plates for outside corner posts.**

- 5.1. Measure in  $1\frac{1}{2}$ " from the outside corner of each plate.
- 5.2. Draw a line and place an "X" before the line for stud placement.
- 5.3. Draw another line  $1\frac{1}{2}$ " (3" from the end) from the first and place a "B" for filler block.
- 5.4. On the outside of the 3" line, place an "X" for the second stud.

**Figure 1-2. Outside Corner Post Layout.**



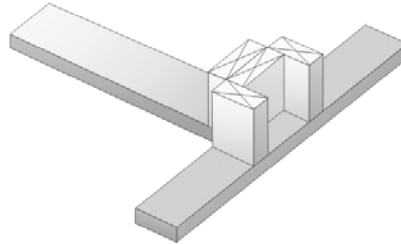
**Step 6: Layout plates for inside corner posts (partitions).**

- 6.1. Refer to floor plan for partition centerline.

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6.2. From the outside corner, measure and mark partition centerline on the plates. Divide the stud width in half ( $3\frac{1}{2} \div 2 = 1\frac{3}{4}$ ). Measure over  $1\frac{3}{4}$ " in each direction from the centerline and strike a line. On the outside of each line, place an "X" for stud locations and place a "B" in the center for filler block location.

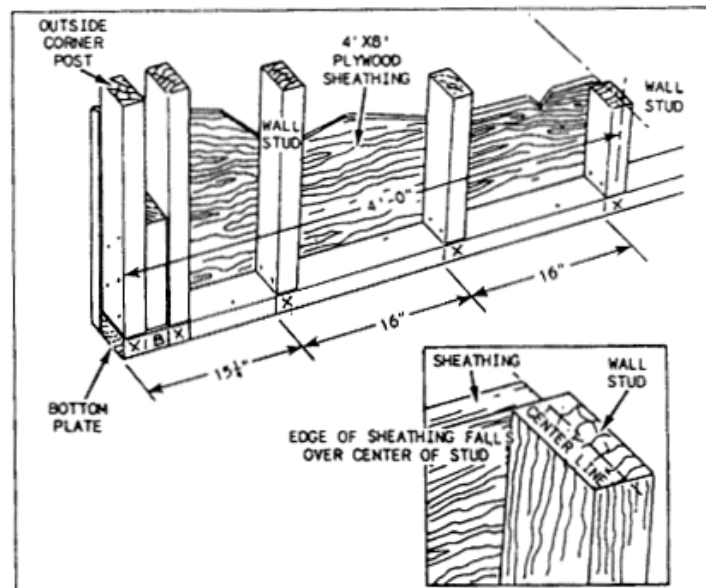
**Figure 1-3. Inside Corner Post Layout.**



**Step 7: Layout plates for studs and cripples.**

- 7.1. From the outside corner, measure in  $15\frac{1}{4}$ " and strike a line.
- 7.2. Place an "X" on the side of the line away from the measuring corner for stud placement.
- 7.3. From the  $15\frac{1}{4}$ " line, measure and strike a line every 16" for the length of the wall.
- 7.4. Place an "X" for all studs and a "C" for all cripple studs in the rough openings.

**Figure 1-4. Wall Layout.**



**Step 8: Cut wall-framing members.**

- 8.1. Cut all studs to the wall height minus the thickness of the plates ( $4\frac{1}{2}$ ").
- 8.2. Cut trimmer studs to the rough opening height minus the sole plate thickness ( $1\frac{1}{2}$ ").
- 8.3. Find the header length by taking the rough opening width and adding the trimmer studs thickness (3"). Cut two boards to this measurement.

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8.4. Cut the rough sill to the rough opening width.

**NOTE:**  
The header and rough sill lengths can be obtained from the plate layouts.

**Step 9: Assemble corner posts and partitions.**

- 9.1. To assemble a corner post, nail two studs together with filler blocks flat in between. This provides a 4 1/2" nailing surface.
- 9.2. For the partition, nail two studs together with the filler blocks laid on edge in between.

**NOTE:**  
Different methods and configurations can be used to assemble these items. Either way, ensure that the blocks are placed flush at each end and one centered in between.

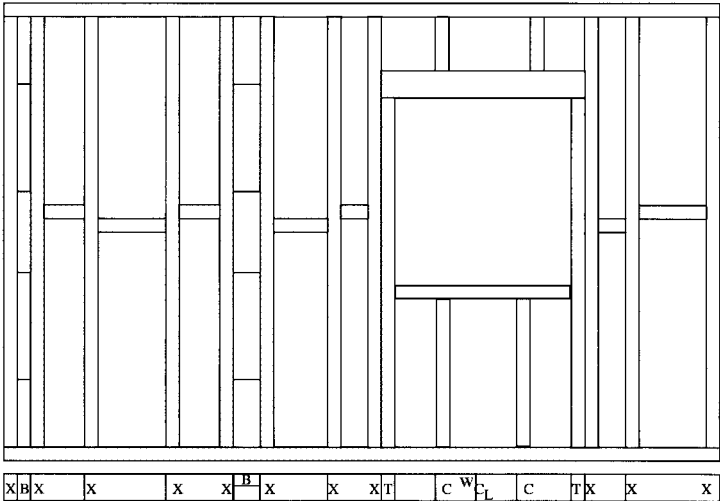
**Step 10: Assemble header.** Headers are assembled with two boards placed on top of each other with a 1/2" spacer in between. Nail them together with 16d driven at an angle approximately 16" on center.

**NOTE:**  
Headers can be made from 2" x 6", 8" or 10" or 12" material. If 2" x 12" material is used in a standard 8' wall, cripple studs are not required above the header.

**Step 11: Assemble wall sections.**

- 11.1. Separate the lower top plate and sole plate and place the studs, corner posts and partitions in between. Ensure the crown for all studs is on the same side.
- 11.2. Nail each member to the plates with 16d common nails.
- 11.3. Mark the header locations using a story pole. Place the headers in position and nail through the studs.
- 11.4. Mark the rough sill locations on the trimmer studs. Place the rough sills between the trimmers and nail through the trimmers into the sills using 16d common nails. Lift this assembly and position it in the desired location. Fasten it to the studs, sole plate and header.
- 11.5. Measure, cut and install cripple studs above and below all openings.

Figure 1-5. Wall Assembly.



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**Step 12: Install plywood wall bracing.**

**12.1.** Use the diagonal method and square the wall.

**12.2.** Install plywood-sheathing flush to the outer edge of the corner post and the sole plate. Snap chalk lines on the intermediate studs and nail the recommended spacing.

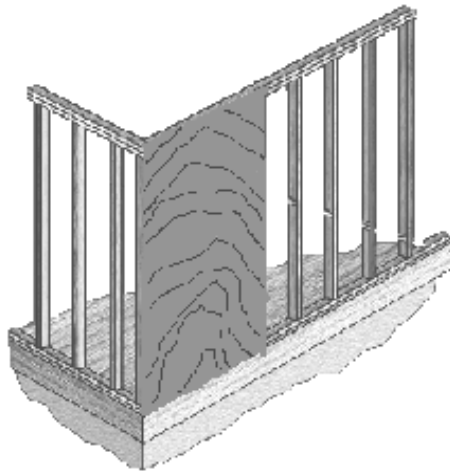
**NOTE:**

The general nail spacing is 6" on the edges and 12" in the field using 8d common nails; however, always refer to the job specifications.

**NOTE:**

Some craftsmen prefer to raise the wall sections before installing the plywood sheathing. Either way is acceptable as long as the walls are plumb and square.

**Figure 1-6. Plywood Bracing.**



**Step 13: Erect wall sections.**

**13.1.** Raise the wall sections into place. Flush the wall with the sub-floor, check plumb and install temporary bracing.

**13.2.** Nail the sole plate to the floor joists or joist header every 16" on center (for wood floors) or secure anchor bolts for concrete slab.

**13.3.** After all walls have been erected, install upper top plates interlocking the walls together.

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**REVIEW QUESTIONS  
FOR  
LAYOUT, CONSTRUCT, AND INSTALL WALLS USING WOODEN STUDS**

QUESTION	ANSWER
1. The wall length can be determined by measuring foundation from corner to corner.	a. True. b. False.
2. If the wall is 16' or less, the plates should be made from solid lumber.	a. True. b. False.
3. To layout partitions on the plates, measure to the partition edge.	a. True. b. False.
4. If you use a 2" x 12" header in a standard 8' wall, no additional cripple studs are needed between the header and top plate.	a. True. b. False.
5. Headers are built using two pieces of material side-by-side with a $\frac{1}{2}$ " spacer between them, nailed with 8d nails every 16" on center.	a. True. b. False.
6. If the bottom plate is anchored to concrete, ensure it is treated lumber.	a. True. b. False.

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## LAYOUT, CONSTRUCT, AND INSTALL WALLS USING WOODEN STUDS

### PERFORMANCE CHECKLIST

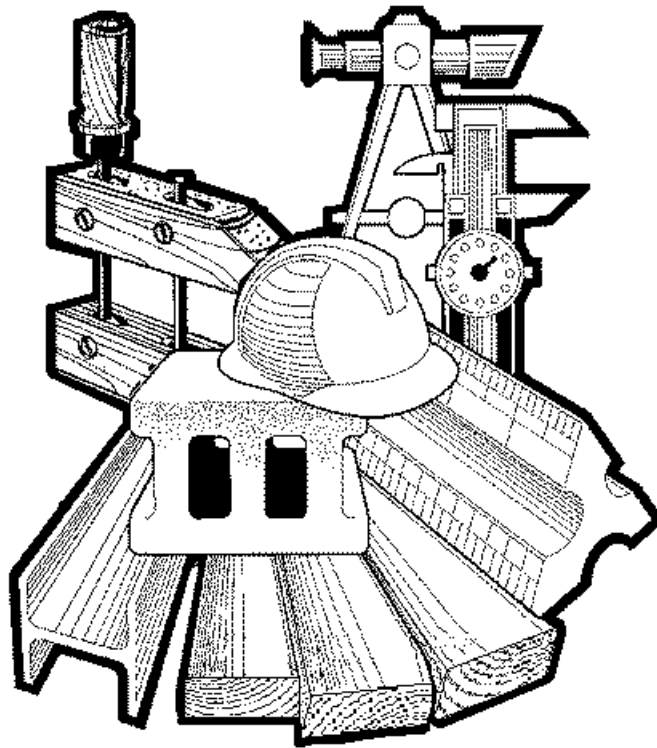
#### INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. identify all components used to frame a wall?		
2. layout the lower top plate and sole plate properly?		
3. cut all material to the correct size?		
4. assemble the corner posts/partitions correctly?		
5. assemble the header correctly?		
6. assemble the wall with all members in their respective places?		
7. square the wall and install plywood bracing with the correct nail spacing?		
8. erect the wall sections flush to the subfloor and plumb?		
9. comply with all safety requirements?		

**FEEDBACK:** Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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## LAYOUT, CONSTRUCT, AND INSTALL:

MODULE 17

AFQTP UNIT 1

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### ROOFS (17.1.5.)

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## LAYOUT, CONSTRUCT, AND INSTALL ROOFS

### *Task Training Guide*

<b>STS Reference Number/Title:</b>	17.1.5. – Layout, construct, and install roofs.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Career Development Course (CDC) Structural Journeyman 3E351C, Volume 3, Unit 1, Section 1-2; <i>Trusses and Rafters</i>.</li> <li>2. Commercial Manual, <i>Modern Carpentry</i> by Willis H. Wagner, 1992.</li> <li>3. Carpentry 3<sup>rd</sup> Edition, Delmar.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E331 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. CDC Structural Journeyman 3E351C, Volume 3, Unit1, Section 1-2.</li> <li>2.2. Modern Carpentry, Unit 9, Roof Framing, pages 197 – 228.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. 25' tape measure.</li> <li>2. Pencil.</li> <li>3. Framing square.</li> <li>4. Circular saw.</li> <li>5. Extension cord.</li> <li>6. Speed square.</li> <li>7. Chalk line.</li> <li>8. Lumber.</li> <li>9. Framing hammer.</li> <li>10. Nails, 16d common.</li> <li>11. Safety glasses.</li> <li>12. Hearing protection.</li> </ol>
<b>Learning Objective:</b>	The trainee should know how to layout and construct 2" x 4" rafters for roof with little or no supervision.
<b>Samples of Behavior:</b>	The trainee should demonstrate how to layout and construct wood-framed roofs.
<b>Notes:</b>	
Any safety violation is an automatic failure.	

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## LAYOUT, CONSTRUCT, AND INSTALL ROOFS

**1. Background.** As a structural journeyman, you may be required to frame a roof. This is a very important tasking. The roof frame is the base that all roofing materials will be attached to. You need to make sure that it is not only strong and rigid, but that it is designed proportionately to the building. Imagine the consequences and embarrassment if your roof failed. Not only is the building's interior subject to water damage, but also thousand to millions of dollars of equipment may be damaged. Knowing the different roof framing members and their functions/locations is a good place to begin on your way to becoming a seasoned craftsman.

**2. Roof Framing.** The following lists some common roof framing members and their functions: (not all members listed are found on all roof styles):

**1.1. Ridge Board.** Ties in the rafters at the roof apex (ridge).

**1.2. Common Rafter.** As the name implies, it is the most common rafter. It runs at a right angle from the wall plate to the ridgeboard. A plain gable roof consists entirely of common rafters.

**1.3. Hip Rafter.** It also runs from the wall plate to the ridge but at a 45-degree angle. It forms the support where two slopes of the roof meet.

**1.4. Valley Rafter.** Similar to a hip rafter, it also runs from the wall plate to the ridge at a 45-degree angle. It forms the hollow where two slopes meet, such as an intersecting roof.

**1.5. Hip Jack.** Runs from the wall plate to the hip rafter.

**1.6. Valley Jack.** Runs from the wall plate to the valley rafter.

**1.7. Cripple Jack.** Never touches either the wall plate or the ridge board. It runs from a hip rafter to a valley rafter.

**1.8. Roof Slope and Pitch.**

**1.8.1. Slope** indicates the roof incline as a ratio of the vertical rise to the horizontal run. A roof that rises 4" for every foot is said to have a 4/12 slope or a 4" **unit of rise**.

**1.8.2. Pitch** indicates the roof incline as a ratio of the vertical rise to the span (twice the run) and is given as a fraction. Example: A total roof rise is 4 feet and the span is 24 feet. The pitch is 1/6 (4/24 reduces to 1/6).

**1.8.3. Span** is the distance between the outside top plates.

**1.8.4. Total run** is half the span.

**1.8.5. Total rise** is the vertical distance from the top (wall) plate to the top of the ridge.

**1.9. Framing Square Table Method.** This is probably the simplest and most accurate way to compute rafter lengths. If you're cutting a large number of rafters, you should carefully layout a template from a true and straight piece of lumber.

**3. Procedures.** Follow these steps to layout, construct, and install roofs:

**NOTE TO TRAINER/CERTIFIER:**

If a roof construction project is not available, the minimum required for upgrade training is the following: Trainer will provide trainee with building dimensions to include roof slope and overhang. Trainee must then accomplish steps 1 – 5 (exception to step 4—only cut out two rafters and 1 collar tie). Steps 6 and 7 must be demonstrated step-by-step ensuring trainee has complete knowledge of tasks.

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**Step 1: Determine rafter line length.**

- 1.1. Locate the section on the framing square labeled “Length Common Rafters Per Foot Run.”
- 1.2. Find the rafter line length per foot of run for the slope you are using. For example, if a 5” rise is needed, look under the number 5. 13.00” is indicated.
- 1.3. Multiply this number by the total run (in feet) to get the rafter line length.

**Step 2: Layout rafters.**

- 2.1. Mark a plumb line for the ridge cut using a framing square. Hold the square for the correct slope, such as 5/12.
- 2.2. Measure the length of the rafter from the plumb line and strike another plumb line at the seat.
- 2.3. Measure up from the seat plumb line 1 ½” and strike a 90-degree angle inward for the seat cut on the bird’s mouth.
- 2.4. Add any measurements for a rafter tail, if required.
- 2.5. Subtract ½ the ridgeboard thickness at the ridge plumb line.
- 2.6. Repeat for other rafter or use as a template.

**Step 3: Layout collar ties.** Collar ties are usually required on every third rafter or 4’, but refer to drawings or local codes for exact placement. To compute the collar tie length, take the drop in inches multiplied by two and divide by the unit of rise. That will give you the length in feet.

**Step 4: Cut out rafters, collar ties and ridgeboard.**

**Step 5: Layout ridgeboard and wall plates.**

- 5.1. Start at one end of the building and layout the wall plates on both sides of the building.
- 5.2. Mark the ridgeboard to account for any overhang. Then continue ridgeboard layout with the same on center spacing.

**NOTE:**

Rafters are usually spaced 24” on center; however, refer to the roof plan or job specifications for the project you are working on.

**Step 6: Erect the roof frame.**

- 6.1. Temporarily install the ridgeboard at the required total rise and nail to temporary support braces at each end of the building.
- 6.2. Using 16d common nails, start installing the rafters by first toenailing through the seat into the wall plate. Then nail through the ridgeboard into the plumb cut on the rafter. Toenail the rafters to the ridgeboard on the opposite side.
- 6.3. Plumb and brace as you proceed from rafter pairs.
- 6.4. Install collar ties as required.
- 6.5. Cut and install gable end studs.
- 6.6. If roof has an overhang, install lookouts using approved method.

**Step 7: Install roof sheathing.** Install plywood sheathing in the same manner as was accomplished in floor framing.

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**REVIEW QUESTIONS  
FOR  
LAYOUT, CONSTRUCT, AND INSTALL ROOFS**

QUESTION	ANSWER
1. A common rafter extends from the wall plate to the ridgeboard.	a. True. b. False.
2. The total run is described as half of the span of the building.	a. True. b. False.
3. To ensure all of your rafters are laid out and cut the same, you should:	a. stack them together and cut them all at once. b. carefully lay out one and use it as a template. c. order them pre-cut. d. None of the above.
4. The Framing Square Table Method is accomplished by stepping off the rafter line length using a framing square.	a. True. b. False.
5. Rafters are fastened to the ridge board by:	a. wood screws. b. construction glue . c. 16d common nails. d. ¼" plywood gussets.

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## LAYOUT, CONSTRUCT, AND INSTALL ROOFS

### PERFORMANCE CHECKLIST

#### INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. determine the correct rafter line length?		
2. select a straight and true piece of lumber to lay out the rafter?		
3. layout the rafter correctly?		
4. mark the bird's mouth correctly?		
5. cut all framing members to the correct size?		
6. layout the ridgeboard and wall plates correctly?		
7. install all framing members in the correct locations?		
8. comply with all safety requirements?		

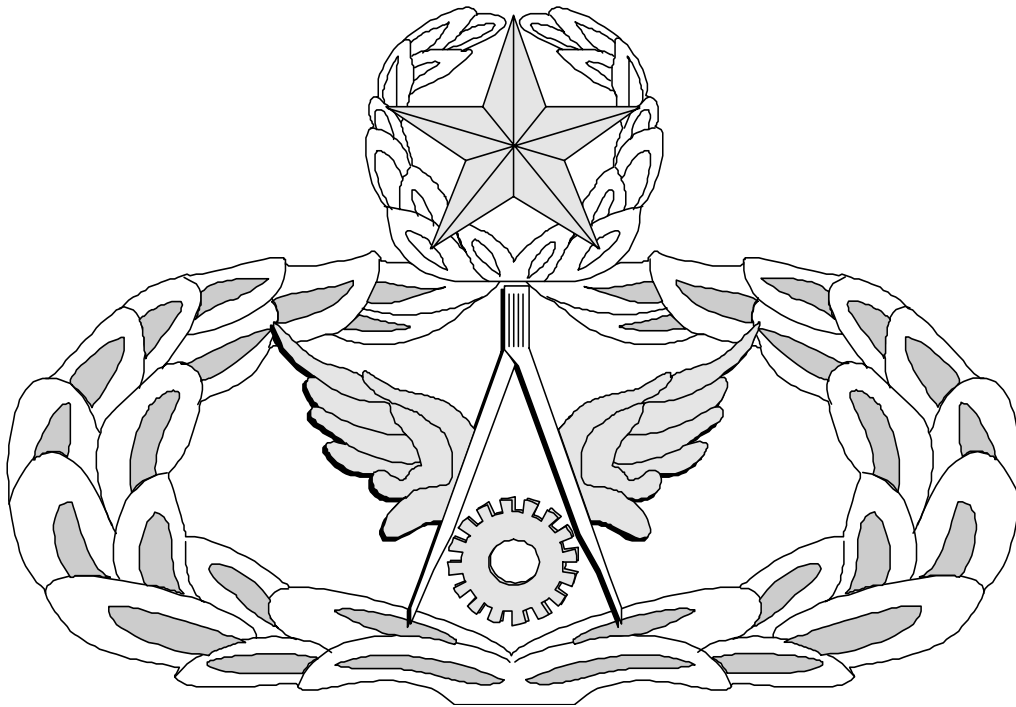
**FEEDBACK:** Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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# Air Force Civil Engineer

## QUALIFICATION TRAINING PACKAGE (QTP)

### REVIEW ANSWER KEY



FOR  
**STRUCTURAL**  
(3E3X1)

### MODULE 17

## STRUCTURAL LAYOUT/FRAMING COMPONENTS

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**Key-1**

**LAYOUT, CONSTRUCT, AND INSTALL FLOORS  
(3E3X1-17.1.1.)**

QUESTION	ANSWER
1. In most residential construction, nominal 2" thick material is used for floor joists.	a. True.
2. Floor joists can span from sill to sill or from sill to girder.	a. True.
3. Floor joists may be spaced from 12" to 24" on center.	a. True.
4. The header joist is nailed to the joist using three 10d nails.	b. False.
5. Bridging is installed at no greater than 8-foot intervals.	a. True.

**LAYOUT, CONSTRUCT, AND INSTRUCT WALLS USING WOODEN STUDS  
(3E3X1-17.1.3.1.)**

QUESTION	ANSWER
1. The wall length can be determined by measuring foundation from corner to corner.	a. True.
2. If the wall is 16' or more, the plates should be made from solid lumber.	b. False.
3. To layout partitions on the plates, measure to the partition edge.	b. False.
4. If you use a 2" x 12" header in a standard 8' wall, no additional cripple studs are needed between the header and top plate.	a. True.
5. Headers are built using two pieces of material side-by-side with a 1/2" spacer between them, nailed with 8d nails every 16" on center.	b. False.
6. If the bottom plate is anchored to concrete, ensure it is treated lumber.	a. True.

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**LAYOUT, CONSTRUCT, AND INSTALL ROOFS**  
**(3E3X1-17.1.5.)**

<b>QUESTION</b>	<b>ANSWER</b>
1. A common rafter extends from the wall plate to the ridge board.	a. True.
2. The total run is described as half of the span of the building.	a. True.
3. To ensure all of your rafters are laid out and cut the same you should:	b. carefully lay out one and use it as a pattern.
4. The Framing Square Table Method is accomplished by stepping off the rafter line length using a framing square.	b. False.
5. Rafters are fastened to the ridge board by:	c. 16d common nails.

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MEMORANDUM FOR HQ AFCESA/CEOF  
139 Barnes Drive Suite 1  
Tyndall AFB, FL 32403-5319

FROM:

SUBJECT: Qualification Training Package Improvement

1. Identify module.

Module # and title \_\_\_\_\_

2. Identify improvement/correction section(s):

_____ STS Task Reference	_____ Performance Checklist
_____ Training Reference	_____ Feedback
_____ Evaluation Instructions	_____ Format
_____ Performance Resources	_____ Other
_____ Steps in Task Performance	

3. Recommended changes--use a continuation sheet if necessary.

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4. You may choose to call in your recommendations to DSN 523-6445 or FAX DSN/Commercial 523-6488 or (850) 283-6488 or email [ceof.helpdesk@tyndall.af.mil](mailto:ceof.helpdesk@tyndall.af.mil).

5. Thank you for your time and interest.

YOUR NAME, RANK, USAF  
Title/Position